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Knowledge analysis of entrance examination knowledge by registered students at the University of Economics, Prague

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Abstract

We present analysis of results of entrance examinations for the University of Economics, Prague in the subject of "Mathematics" and "English" in our paper. For anonymous data we carried out statistical analysis that take into account dimensions like time series for years 2010-2012, type of high school and country of origin of applicants for study.
Conclusions then point to the better results in admission tests found in case of foreign students and declining number of points acquired in time for all applicants. Overall analysis may be evaluated as a declining number of points acquired while maintaining unchanged difficulty of examination.

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Keywords: Knowledge; Mathematics; English; Education Process, Entrance Examination

1. Introduction

Together with the way in which the demographic distribution of the population in the Czech Republic changes, especially in the "teenage" group, there are also gradual changes in the models according to which the education system is regulated (Fischer, Finardi, 2010), (Finardi, Fischer, Mazouch, 2012), (Kunstova, 2012), (Kunstova, Rezankova, 2012). The uneven population curve of different periods causes a shortage of pupils and students at individual levels of the education system, (Doucek, Maryska, Novotny 2012). These gaps in numbers then on the one hand cause a drop in the number of educational institutions when there is a drop in the number of students, and on the other hand there are situations when there are insufficient institutions when the number of students rises. The present situation, where there has been an expected decline since 2011 in the population years, which

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might enter the sector of tertiary education, will quite certainly leave, together with the long-term economic recession, strong marks both on the number and the structure of university education in the Czech Republic (Finardi, Fischer, 2011) (Doucek, Kunstova, Maryska, 2011).

With a view to the expected structural changes (Hanclova, Doucek, 2012), we at the University of Economics, Prague (UEP) prepared and elaborated a project, dealing with the analysis of the data from the entrance exams at the University of Economics, Prague divided up according to the type of exam, faculty and eventually also subject, and subsequently evaluating in the simplest version the results achieved in time; in the more complicated versions it then also investigates the relations between the results of the entrance exams and the results achieved in the individual study courses, including the bachelor's course state examinations. The aim of the project is, in particular, to answer the following questions:

- What is the level of knowledge of the students who apply to study at the UEP from secondary schools in the subjects of "Mathematics" and "Foreign Language" (in this article presented results are for the "English language")? How does this knowledge develop in analyzed period, or is this level of knowledge dependent on the type of secondary school?
- Are there any links between the results achieved in the entrance exams and the results in the courses during their studies?
- Are there relationships between the results achieved in the entrance exams and the results of the state examinations of bachelor degree courses?

In this article, only the results of the basic analyses of the entrance procedure in "Mathematics" and "English" are presented. Its aim is, then, to analyze the results of the students applying for admission to the UEP in the years 2010 – 2012 according to nationality and time.

The starting points for the proposed models and analyses were in particular studies (Psacharopoulos, 1995) and the experience gained at the University of Economics, Prague from earlier projects with a similar theme (Scholleova, Mikovcova, 2011) and research on the education systems of European countries (Maryska, Doucek, 2011) and (Ala-Mutka, Punie, Redecker, 2008), (Maryska, Doucek, Novotny, 2012).

2. Methods and Data Collection

The data for this project are collected regularly in the course of the admissions procedure from all applicants for studies. In accordance with the provisions of Law No. 101/2000 Coll., on the protection of personal data, the data of applicants are rendered anonymous for the requirements of processing and are then worked with in such a way that all personal identification factors are removed and they are processed in such a way that there is no possibility of ascertaining which applicants they originally indicated.

Further data on the results of the exams are acquired from the university information system by a single transfer of data. The actual analysis and modeling then takes place on inter-connected and completely anonymous data.

The database does not contain all the data of applicants for study at all faculties of the University of Economics, Prague because some faculties do not have exactly the same admission procedure and one faculty admits Czech students on the basis of SCIO tests (SCIO is a leading CEE educational assessment centre offering commercial services to schools, universities, self-governing institutions, school boards and other institutions in the Czech Republic. The company is engaged in development of state-of-the-art products and services aimed at education and student assessment.). For this reason we do not have the data on the results of their entrance exams at our disposal. We do, however, have the data on the level of SCIO points achieved and the data from subsequent examinations in individual subjects. We also subject these facts to further analysis, but not in this article due to the lack of space.

2.1. Methodology

The primary data used for evaluation were imported to the database of the MS SQL Server through extracts in the form of text files. These were exported from the central database of the University of Economics, Prague. Connected number registers were also available, enabling the clarification of primary data.

For the processing of data a data model was created in the MS SQL Server 2008 R/2 application. This model respects the principles of business intelligence, thanks to which it was possible to create analytical data cubes (OLAP). (Kimball & Caserta, 2004; Imhoff, Gelammo & Geiger, 2003), (MacLennan, Tang, Crivat, 2009).

For the analysis of the data we used two different approaches. The first was based on the use of OLAP cubes in the MS SQL Server 2008 R/2, in which a larger number of statistical indexes was created (e.g. median, average, maximum, minimum, determining deviation, etc.), enabling the data to be statistically described.

The second approach to the evaluation of the data was based on the use of the Microsoft Excel 2010 application. Through this the acquired data was also analyzed by means of statistical methods.

The combination of suitable dimensions (for instance Year of entrance exam, Selected study subject, Language of entrance exam, etc.) with the selected indexes (Number of applicants for study, Average value of points acquired in the language entrance test, Average value of results of mathematics entrance test, correlation between points achieved, etc.) made it possible to analyze the data effectively and in great detail and thus identify both the trends and the mutual links between data.

The combination of the two above approaches enabled both the mutual verification of the results achieved by the functions of various technologies, and especially the extension in this way of the range of possible statistical analyses. The reason for this is the fact that the groups of functions in the applications MS SQL Server and MS Excel are partly disjunctive.

3. Results and Discussion

Among the primary results of the investigation is finding out how many students submitted applications to study at the University of Economics, Prague and what the level of admission to the individual faculties was. For the requirements of this paper there are two basic groups of results – on the one hand the overall analysis of the structure of applicants for study, the proportions of applicants according to country of origin, and then the results achieved in the entrance exam in “Mathematics” and in “English”. The decline in the number of students from the Czech Republic may also be supplemented at Czech schools by admitting students from other countries, or eventually also by what is called delayed demand (studying after several years of practical work experience) (Kunstova, 2011). This is why part of the analyses carried out was not only the number of foreign students applying for admission to the VSE, but also a more detailed analysis of the results of their admission procedure. In this paper, however, there is no room for greater detail and so in Table 1 we give only the proportions of the first six countries in the number of students applying to study at the University of Economics, Prague.

Table 1: Proportions of Applicants for Study at the UPE According to Country Source: Authors

UEP Applicants	2010	2011	2012
Czech Republic	85.51%	84.22%	83.36%
Slovak Republic	8.05%	8.07%	7.85%
Russian Federation	2.11%	3.18%	3.07%
Vietnam Socialist Republic	0.81%	1.29%	1.47%
Ukraine	1.06%	1.26%	1.45%
Kazakhstan	0.60%	0.85%	0.92%

The proportion of students from the Czech Republic is not surprising, nor is the position of Slovakia in second place surprising. The next countries in order being the Russian Federation and especially Vietnam are, however, a surprise, as is the sixth place of the Republic of Kazakhstan. There is a surprising increase in the number of students claiming Vietnamese nationality. Here we cannot distinguish whether these are really students straight from Vietnam or students who are permanently resident in the Czech Republic and claim Vietnamese nationality. Tab. 1 can be evaluated as a slow but constant decline in the numbers of Czech and Slovak students at the expense of students from other countries, which confirms the expected demographic trend (Doucek et al., 2012).

3.1. Initial Knowledge of "Mathematics"

In general it may be said of the results of the entrance examinations in "Mathematics" that the average level of points achieved declines in the individual years. The incline of the set is slowly returning to a normal division from negative values (the number of smaller values is dropping compared with the middle value) and the spikiness of the set, on the contrary, is growing (more values collecting around the middle value). The scatter is, de facto, unchanged. A very interesting fact is the value of the characteristic Modus – at the level of 100.00 points. Fig. 1 provides more information on this value.

If we started off from the optimum situation, then the values given in Fig. 1 should take on roughly the shape of normal distribution. From the values given in Fig. 1 it is evident that the data ascertained does not follow this distribution. This may be caused in particular by the fact that the entrance exam in "Mathematics" is based on teaching matter generally known to students of all types of secondary schools (detail given in the Table 2) and the majority of the better students master this. A second aspect of the matter is the absence of more difficult examples, which would sort out the applicants at the top end of the point's spectrum. The question is, however, whether such classification is strictly essential given the declining demographic curve and whether for the needs of admission to the UEP it is not sufficient to divide up the applicants into those who acquire a number of points around the median in the entrance exam and those we accept. An important part is also played here by the number of students admitted to the individual faculties or subjects.

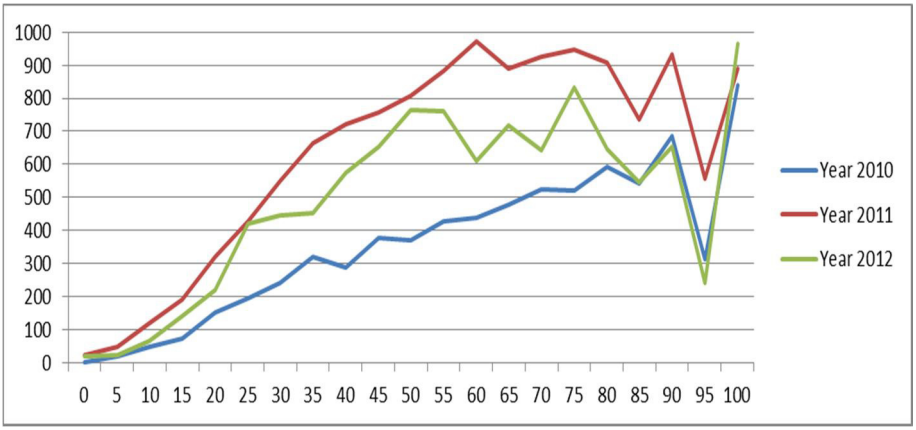

Fig. 1. Frequency of Occurrence of Numbers of Acquired Points from the Entrance Exams in "Mathematics" 2010 – 2012 Source: Authors

In the analysis of the results of the entrance exams in "Mathematics" we also dealt with the results achieved according to the nationality of the applicant.

Table 2. Results of the Entrance Exams in "Mathematics" According to Country of Origin of the Students Source: Authors

Mathematics	2010		2011		2012	
	Avg.	Med	Avg.	Med	Avg.	Med.
Czech Republic	65.53	70.00	61.36	60.00	59.72	60.00
Slovak Republic	73.57	80.00	67.63	70.00	67.37	70.00
Russian Federation	79.44	85.00	71.89	75.00	77.81	80.00
Vietnam Socialist Republic	69.16	70.00	68.03	70.00	68.36	70.00
Ukraine	74.69	80.00	71.29	75.00	64.65	65.00
Kazakhstan	78.53	80.00	68.04	85.00	73.86	80.00

On first looking at the Table 2 we can see that the level of the number of points achieved is smallest in the case of the Czech students. On the one hand this is due to the number of applicants. They are applying to study at a university in their own land and therefore the range of applicants is wider than in the case of students coming from abroad and with certainly greater motivation. The countries of the former Soviet Union demonstrate traditionally good preparation in the exact sciences, which our investigation also confirmed. Although here too the number of points acquired is showing a certain decline in time.

A more detailed look at the Czech students, or rather at the results of their entrance exams, is shown in the Table 3. This table shows that, according to expectation, the best results are those of grammar school students. Students from grammar schools (gymnasia) are also the majority group of applicants for study at the UEP (Table 3). But even in this index we can trace a decline in the number of points gained in the entrance exam in practically all types of schools in time.

Table 3. Results of the Entrance Exams in "Mathematics" According to Type of Secondary School Source: Authors

Mathematics	2010			2011			2012		
	n %	Avg.	Med	n %	Avg.	Med	n %	Avg.	Med
Grammar School	68.25	72.28	75.00	65.74	66.96	70.00	62.14	65.11	68.00
Economics School	17.75	58.29	60.00	20.57	53.14	50.00	21.95	52.37	50.00
Vocational School	14.00	49.87	45.00	13.69	47.42	45.00	15.92	48.62	45.00

From the Table 3, it emerges that in course of three consecutive periods we can identify only a declining trend in level of knowledge represented by average number of points achieved in entrance exam. The only exceptions are Vocational Secondary Schools, which in 2012 showed a slight increase in number of points gained.

3.2. Initial knowledge of "English"

The English language was identified as the most frequent language for applicants at University of Economics, Prague. Summarizing of data is presented on the Table. 3

Table 4. Results of the Entrance Exams in Foreign Languages 2010 - 2012 Source: Authors

	Total in 3 Years	2010	2011	2012
English	77.31%	76.63%	76.95%	78.04%

German	12,98%	14,33%	12,77%	12.43%
French	6.08%	5.58%	6.61%	5.85%
Spain	3.63%	3.46%	3.67%	3.68%
Total	100.00%	100.00%	100.00%	100.00%

Added information from the Table 4 is that more than three fourth of applicants prefer „English“ as the first language. There were identified faculties (Faculty of Finance and Accounting and some specializations on Faculty of Informatics – for example Applied Informatics), where language entrance examination is performed only in „English“. Other foreign languages in what the entrance examinations are preformed at UEP are Russian and Italian languages, but the share of applicants making entrance exams in these languages represents only 1.5 % of all applicants. Other aspect is the evaluation of results in „English“ according to the applicant's country of origin – the Table 4.

Table 5. Results of the Entrance Exams in Foreign Languages 2010 - 2012 Source: Authors

English	2010		2011		2012	
	Avg.	Med	Avg.	Med	Avg.	Med.
Czech Republic	66.50	68.00	66.95	68.00	65.99	67.50
Slovak Republic	74.79	78.00	72.06	74.00	72.44	74.00
Russian Federation	74.29	78.00	71.59	74.00	72.07	74.00
Vietnam Socialist Republic	66.98	70.00	73.16	76.00	72.91	76.00
Ukraine	74.69	80.00	71.63	74.00	67.56	68.00
Kazakhstan	75.60	78.00	66.98	70.00	71.84	76.00

The best knowledge of "English" was identified by applicants for Kazakhstan in 2010, but in three year this knowledge declined to the fourth place behind applicants from Vietnam Socialist Republic, Slovak Republic and Russian Federation. Knowledge of Czech applicants is the worst of all investigated countries, but the lagging off is not so dramatically.

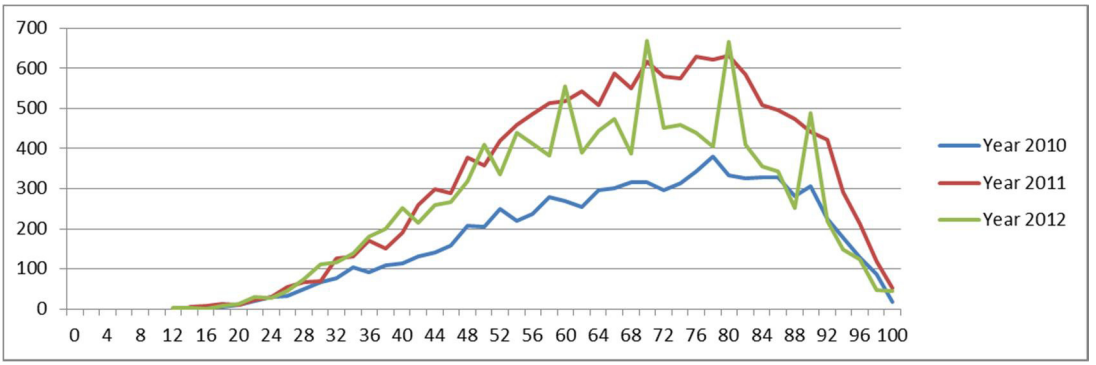

Fig. 2. Frequency of Occurrence of Numbers of Acquired Points from the Entrance Exam in "English" 2010 – 2012 Source: Authors

Other question (the second one) was related to the occurrence of numbers of acquired points from „English“. The reconstructed curve is visible on Figure. 1 and it reflects the normal distribution, as was expected during the survey.

From the Table 6 it emerges that in the course of three consecutive periods we can identify an only declining trend in the level of knowledge represented by the average number of points achieved in the entrance exam. The

only exceptions are the Vocational Secondary Schools, which in 2011 and 2012 showed a slight increase in the number of points gained.

Table 6. Results of the Entrance Exams in "English" 2010 - 2012 Source: Authors

English	2010			2011			2012		
	n %	Avg.	Med	n %	Avg.	Med	n %	Avg.	Med
Grammar Schools	60.83	72.53	74.00	65.26	72.13	74.00	61.40	71.78	74.00
Economics Schools	23.36	59.32	58.00	20.20	58.45	58.00	21.65	57.18	56.00
Vocational Schools	15.80	54.69	54.00	14.53	55.61	54.00	16.96	56.23	56.00

The better quality of „English" learning process seems to be visible (difference for more than 10 per cents of gained points) identified in grammar schools, although the level of gained points is slightly but permanently decreasing during the investigated period.

4. Conclusion

Research into the admission procedure at the University of Economics, Prague was originally undertaken in an effort to acquire basic material to strengthen the qualified decision-making of top management of faculties regarding the manner of admission of applicants to the university. For these needs we used standard statistical methods for statistical analysis on the data we acquired from the entrance exams of applicants for study. For the requirements of this paper and with regard to its limited possibilities we present here only part of the results achieved for the subject of "Mathematics" and "English".

The decisive share of applicants for study at the University of Economics, Prague comes from the Czech Republic (this share is dropping very slightly). The second most numerous group consists of applicants from the Slovak Republic (their share is also dropping very slightly); the next group are students from the Russian Federation (their number has increased by one percentage point in the three years studied), followed by students from Ukraine.

In the analysis of the collected data for "Mathematics" we reached the following results in particular:

- The number of points acquired in the entrance exam in "Mathematics" is constantly dropping although the difficulty of these tests remains the same. This applies regardless of the nationality of the students or the type of secondary school the applicants attended. The results achieved in the admission procedure are not regulated by normal classification, but have the tendency to separate out the average and below-average applicants from the others – the borderline is somewhere around 55.00 – 60.00 points. The entrance exam also does not identify applicants who are really outstanding in mathematics.
- The best level of "Mathematics" education procedures was identified by grammar schools.

In the analysis of the collected data we reached the following results for "English" in particular:

- English language is the most frequent langue of applicants for study on UEP; approximately more than ¾ of applicants selected "English" as the language for entrance procedure; the best results in points gained present applicants from Vietnam Socialist Republic, Slovak Republic and Russian Federation.
- The occurrence of numbers of acquired points from „English" reflects the normal distribution; it corresponds to presumption, that questions and exercises entrance exams are correctly prepared and examinations give real mirror of applicant's knowledge.
- The best quality of "English" education procedures was identified by grammar schools.

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